

10-26-00

A

Please type a plus sign (+) inside this box → ☒

Approved for use through 09/30/2000. OMB 0651-0032
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

UTILITY PATENT APPLICATION TRANSMITTAL <small>(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))</small>	Attorney Docket No.	13240(A)
	First Inventor or Application Identifier	MILLER, DAVID
	Title	Programmable Self-Operating Compact Disc Duplication System
	Express Mail Label No.	EK687096054US

APPLICATION ELEMENTS <small>See MPEP chapter 600 concerning utility patent application contents.</small>	ADDRESS TO: Assistant Commissioner for Patents Box Patent Application Washington, DC 20231
1. <input checked="" type="checkbox"/> * Fee Transmittal Form (e.g., PTO/SB/17) <small>(Submit an original and a duplicate for fee processing)</small> 2. <input checked="" type="checkbox"/> Specification [Total Pages 36] <small>(preferred arrangement set forth below)</small> - Descriptive title of the Invention - Cross References to Related Applications - Statement Regarding Fed sponsored R & D - Reference to Microfiche Appendix - Background of the Invention - Brief Summary of the Invention - Brief Description of the Drawings (if filed) - Detailed Description - Claim(s) - Abstract of the Disclosure 3. <input checked="" type="checkbox"/> Drawing(s) (35 U.S.C. 113) [Total Sheets 8] 4. Oath or Declaration [Total Pages 2] a. <input checked="" type="checkbox"/> Newly executed (original or copy) b. <input type="checkbox"/> Copy from a prior application (37 C.F.R. § 1.63(d)) <small>(for continuation/divisional with Box 16 completed)</small> i. <input type="checkbox"/> DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).	5. <input type="checkbox"/> Microfiche Computer Program (Appendix) 6. Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary) a. <input type="checkbox"/> Computer Readable Copy b. <input type="checkbox"/> Paper Copy (identical to computer copy) c. <input type="checkbox"/> Statement verifying identity of above copies
ACCOMPANYING APPLICATION PARTS	
7. <input checked="" type="checkbox"/> Assignment Papers (cover sheet & document(s)) 8. <input checked="" type="checkbox"/> 37 C.F.R. § 1.73(b) Statement <input checked="" type="checkbox"/> Power of Attorney <small>(when there is an assignee)</small> 9. <input type="checkbox"/> English Translation Document (if applicable) 10. <input type="checkbox"/> Information Disclosure Statement (IDS)/PTO-1449 <input type="checkbox"/> Copies of IDS Citations 11. <input type="checkbox"/> Preliminary Amendment 12. <input checked="" type="checkbox"/> Return Receipt Postcard (MPEP 503) <small>(Should be specifically itemized)</small> 13. <input checked="" type="checkbox"/> * Small Entity Statement(s) <input type="checkbox"/> Statement filed in prior application, Status still proper and desired <small>(PTO/SB/09-12)</small> 14. <input type="checkbox"/> Certified Copy of Priority Document(s) <small>(if foreign priority is claimed)</small> 15. <input type="checkbox"/> Other:	
* NOTE FOR ITEMS 1 & 13: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).	

16. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment:

☐ Continuation ☒ Divisional ☐ Continuation-in-part (CIP) of prior application No: 09 / 152,815

Prior application information: Examiner HUBER, PAUL W. Group / Art Unit: 2753

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

17. CORRESPONDENCE ADDRESS

☐ Customer Number or Bar Code Label (Insert Customer No. or Attach bar code label here) or ☒ Correspondence address below

Name	RICHARD ESTY PETERSON		
	PATENT ATTORNEY		
Address	1905-D PALMETTO AVENUE		
City	PACIFICA	State	CA
		Zip Code	94044
Country	United States	Telephone	(650) 557-5708
		Fax	(650) 557-5716

Name (Print/Type)	Richard Esty Peterson	Registration No. (Attorney/Agent)	26,495
Signature	<i>Richard Esty Peterson</i>	Date	10/25/2000

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

**FEE TRANSMITTAL
for FY 2000**

Patent fees are subject to annual revision.
Small Entity payments must be supported by a small entity statement,
otherwise large entity fees must be paid. See Forms PTO/SB/09-12.
See 37 C.F.R. §§ 1.27 and 1.28.

TOTAL AMOUNT OF PAYMENT (\$) 395.00**Complete if Known**

Application Number	
Filing Date	
First Named Inventor	MILLER, DAVID
Examiner Name	
Group / Art Unit	
Attorney Docket No.	13240(A)

METHOD OF PAYMENT (check one)

1. ☐ The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to:

Deposit
Account
NumberDeposit
Account
Name
☐ Charge Any Additional Fee Required
Under 37 CFR §§ 1.16 and 1.17

2. ☒ **Payment Enclosed:**

☒ Check ☐ Money Order ☐ Other
FEE CALCULATION**1. BASIC FILING FEE**

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
101 690	201 345	Utility filing fee	355.00
106 310	206 155	Design filing fee	
107 480	207 240	Plant filing fee	
108 690	208 345	Reissue filing fee	
114 150	214 75	Provisional filing fee	

SUBTOTAL (1) (\$) 355.00**2. EXTRA CLAIM FEES**

Total Claims	Extra Claims	Fee from below	Fee Paid
-20** =		X	
Independent Claims - 3** =		X	
Multiple Dependent			

**or number previously paid, if greater; For Reissues, see below

Large Entity Small Entity

Fee Code (\$)	Fee Code (\$)	Fee Description
103 18	203 9	Claims in excess of 20
102 78	202 39	Independent claims in excess of 3
104 260	204 130	Multiple dependent claim, if not paid
109 78	209 39	** Reissue independent claims over original patent
110 18	210 9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) (\$) **FEE CALCULATION** (continued)**3. ADDITIONAL FEES**

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
105 130	205 65	Surcharge - late filing fee or oath	
127 50	227 25	Surcharge - late provisional filing fee or cover sheet.	
139 130	139 130	Non-English specification	
147 2,520	147 2,520	For filing a request for reexamination	
112 920*	112 920*	Requesting publication of SIR prior to Examiner action	
113 1,840*	113 1,840*	Requesting publication of SIR after Examiner action	
115 110	215 55	Extension for reply within first month	
116 380	216 190	Extension for reply within second month	
117 870	217 435	Extension for reply within third month	
118 1,360	218 680	Extension for reply within fourth month	
128 1,850	228 925	Extension for reply within fifth month	
119 300	219 150	Notice of Appeal	
120 300	220 150	Filing a brief in support of an appeal	
121 260	221 130	Request for oral hearing	
138 1,510	138 1,510	Petition to institute a public use proceeding	
140 110	240 55	Petition to revive - unavoidable	
141 1,210	241 605	Petition to revive - unintentional	
142 1,210	242 605	Utility issue fee (or reissue)	
143 430	243 215	Design issue fee	
144 580	244 290	Plant issue fee	
122 130	122 130	Petitions to the Commissioner	
123 50	123 50	Petitions related to provisional applications	
126 240	126 240	Submission of Information Disclosure Stmt	
581 40	581 40	Recording each patent assignment per property (times number of properties)	40.00
146 690	246 345	Filing a submission after final rejection (37 CFR B 1.129(a))	
149 690	249 345	For each additional invention to be examined (37 CFR B 1.129(b))	

Other fee (specify) _____

Other fee (specify) _____

* Reduced by Basic Filing Fee Paid

SUBTOTAL (3) (\$) 40.00**SUBMITTED BY**Name (Print/Type) **RICHARD ESTY PETERSON**Registration No.
(Attorney/Agent)

26,495

Complete (if applicable)

Telephone (650) 557-5708

Signature

Richard Esty Peterson

Date

10/25/2000

WARNING:

Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

**STATEMENT CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) & 1.27(b))--INDEPENDENT INVENTOR**

Docket Number (Optional)
13240(A)

Applicant, Patentee, or Identifier: **DAVID MILLER**

Application or Patent No.: _____

Filed or Issued: _____

Title: **PROGRAMMABLE SELF-OPERATING COMPACT DISK DUPLICATION SYSTEM**

As a below named inventor, I hereby state that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees to the Patent and Trademark Office described in:

- ☒ the specification filed herewith with title as listed above.
☐ the application identified above.
☐ the patent identified above.

I have not assigned, granted, conveyed, or licensed, and am under no obligation under contract or law to assign, grant, convey, or license, any rights in the invention to any person who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern, or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

- ☐ No such person, concern, or organization exists.
☒ Each such person, concern, or organization is listed below.

WORDTECH SYSTEMS, INC.

Separate statements are required from each named person, concern, or organization having rights to the invention stating their status as small entities. (37 CFR 1.27)

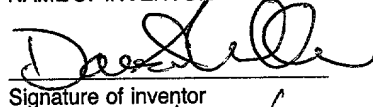
I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

DAVID MILLER

NAME OF INVENTOR

NAME OF INVENTOR

NAME OF INVENTOR



Signature of inventor

Signature of inventor

Signature of inventor

Date

10/23/00

Date

Date

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

**STATEMENT CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) & 1.27(c))--SMALL BUSINESS CONCERN**

Docket Number (Optional)
13240(A)

Applicant, Patentee, or Identifier: DAVID MILLER

Application or Patent No.: _____

Filed or Issued: _____

Title: PROGRAMMABLE SELF-OPERATING COMPACT DISK DUPLICATION SYSTEM

I hereby state that I am

- ☐ the owner of the small business concern identified below:
☒ an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF SMALL BUSINESS CONCERN WORDTECH SYSTEMS, INC.

ADDRESS OF SMALL BUSINESS CONCERN 4020 Pike Lane, Concord, CA 94520

I hereby state that the above identified small business concern qualifies as a small business concern as defined in 13 CFR Part 121 for purposes of paying reduced fees to the United States Patent and Trademark Office. Questions related to size standards for a small business concern may be directed to: Small Business Administration, Size Standards Staff, 409 Third Street, SW, Washington, DC 20416.

I hereby state that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention described in:

- ☒ the specification filed herewith with title as listed above.
☐ the application identified above.
☐ the patent identified above.

If the rights held by the above identified small business concern are not exclusive, each individual, concern, or organization having rights in the invention must file separate statements as to their status as small entities, and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d), or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern, or organization having any rights in the invention is listed below:

- ☐ no such person, concern, or organization exists.
☒ each such person, concern, or organization is listed below.


Separate statements are required from each named person, concern or organization having rights to the invention stating their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

NAME OF PERSON SIGNING DAVID MILLER

TITLE OF PERSON IF OTHER THAN OWNER PRESIDENT

ADDRESS OF PERSON SIGNING 20 La Espiral, Orinda, CA 94563

SIGNATURE  DATE 10/23/00

CERTIFICATE OF MAILING BY
EXPRESS MAIL

I hereby certify that this correspondence is being deposited with the United States Postal Service as "**EXPRESS MAIL**" in an envelope addressed to the Assistant Commissioner for Patents, Box Patent Application, Washington, D.C. 20231 on October 25, 2000.
Express Mail No.: EK687096054US

By: Sallie Whitsett
Sallie Whitsett

003207 9698980

PATENT

DAVID MILLER

* * * * *

SPECIFICATION AND CLAIM

* * * * *

FOR

* * *

LETTERS PATENT

* * * * *

FOR

* * *

**PROGRAMMABLE SELF-OPERATING
COMPACT DISK DUPLICATION SYSTEM**

* * * * *

**RICHARD ESTY PETERSON
PATENT ATTORNEY
1905-D Palmetto Avenue
Pacifica, CA 94044**

13240(A)

PROGRAMMABLE SELF-OPERATING COMPACT DISK DUPLICATION SYSTEM

ABSTRACT OF THE DISCLOSURE

A system for the duplication of binary data onto CD-R disks, the system including a copy unit, a host computer and computer software, the software being installed in the host computer to provide a user interface and to direct the transfer of data from the host computer to the copy unit, the copy unit including a set of multiple stacked recordable disk drives, a microprocessor electronically connected to the activating mechanism of a pivotal transport tower and to the set of multiple stacked recordable disk drives. A robotic disk pickup head on the pivotal transport tower is encompassed by a set of disk spindle members arranged in a symmetric semi-circular pattern around the central tower, the disk pickup head being connected to the pivotal transport tower with an elevator mechanism for lifting and transporting compact disks among the disk spindle members and any selected one of the stacked recordable disk drive members. The microprocessor concurrently directs the movement of the disk pickup head and the copying of data to the CD-R disks in the disk drive members. After a disk copy operation is completed, the computer software and microprocessor may direct the stacked recordable disk drive members to inspect the burned CD-R disks for copy errors and further direct the disk pickup head to remove and eject defective burned CD-R disks and place properly burned CD-R disks on a specified disk spindle member. The system allows for source data to be read from multiple master compact disks inserted in specified stacked recordable disk drive members to provide for random access copying

from the multiple master compact disks.

[illegible]

BACKGROUND OF THE INVENTION

This is a continuation-in-part of my application of the same title, Serial No. 08/816,257, filed 13 March 1997.

5 Digital compact disks were originally conceived in the early 1980's as a technique to accurately copy and preserve audio recordings intended for sale to a mass market of consumers. As computing power has increased exponentially since that time, information processing tasks unthinkable only a few years ago have become commonplace and require large amounts of data most economically and conveniently stored on digital compact disks.

10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
120
125
130
135
140
145
150
155
160
165
170
175
180
185
190
195
200
205
210
215
220
225
230
235
240
245
250
255
260
265
270
275
280
285
290
295
300
305
310
315
320
325
330
335
340
345
350
355
360
365
370
375
380
385
390
395
400
405
410
415
420
425
430
435
440
445
450
455
460
465
470
475
480
485
490
495
500
505
510
515
520
525
530
535
540
545
550
555
560
565
570
575
580
585
590
595
600
605
610
615
620
625
630
635
640
645
650
655
660
665
670
675
680
685
690
695
700
705
710
715
720
725
730
735
740
745
750
755
760
765
770
775
780
785
790
795
800
805
810
815
820
825
830
835
840
845
850
855
860
865
870
875
880
885
890
895
900
905
910
915
920
925
930
935
940
945
950
955
960
965
970
975
980
985
990
995
1000
1005
1010
1015
1020
1025
1030
1035
1040
1045
1050
1055
1060
1065
1070
1075
1080
1085
1090
1095
1100
1105
1110
1115
1120
1125
1130
1135
1140
1145
1150
1155
1160
1165
1170
1175
1180
1185
1190
1195
1200
1205
1210
1215
1220
1225
1230
1235
1240
1245
1250
1255
1260
1265
1270
1275
1280
1285
1290
1295
1300
1305
1310
1315
1320
1325
1330
1335
1340
1345
1350
1355
1360
1365
1370
1375
1380
1385
1390
1395
1400
1405
1410
1415
1420
1425
1430
1435
1440
1445
1450
1455
1460
1465
1470
1475
1480
1485
1490
1495
1500
1505
1510
1515
1520
1525
1530
1535
1540
1545
1550
1555
1560
1565
1570
1575
1580
1585
1590
1595
1600
1605
1610
1615
1620
1625
1630
1635
1640
1645
1650
1655
1660
1665
1670
1675
1680
1685
1690
1695
1700
1705
1710
1715
1720
1725
1730
1735
1740
1745
1750
1755
1760
1765
1770
1775
1780
1785
1790
1795
1800
1805
1810
1815
1820
1825
1830
1835
1840
1845
1850
1855
1860
1865
1870
1875
1880
1885
1890
1895
1900
1905
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
2075
2080
2085
2090
2095
2100
2105
2110
2115
2120
2125
2130
2135
2140
2145
2150
2155
2160
2165
2170
2175
2180
2185
2190
2195
2200
2205
2210
2215
2220
2225
2230
2235
2240
2245
2250
2255
2260
2265
2270
2275
2280
2285
2290
2295
2300
2305
2310
2315
2320
2325
2330
2335
2340
2345
2350
2355
2360
2365
2370
2375
2380
2385
2390
2395
2400
2405
2410
2415
2420
2425
2430
2435
2440
2445
2450
2455
2460
2465
2470
2475
2480
2485
2490
2495
2500
2505
2510
2515
2520
2525
2530
2535
2540
2545
2550
2555
2560
2565
2570
2575
2580
2585
2590
2595
2600
2605
2610
2615
2620
2625
2630
2635
2640
2645
2650
2655
2660
2665
2670
2675
2680
2685
2690
2695
2700
2705
2710
2715
2720
2725
2730
2735
2740
2745
2750
2755
2760
2765
2770
2775
2780
2785
2790
2795
2800
2805
2810
2815
2820
2825
2830
2835
2840
2845
2850
2855
2860
2865
2870
2875
2880
2885
2890
2895
2900
2905
2910
2915
2920
2925
2930
2935
2940
2945
2950
2955
2960
2965
2970
2975
2980
2985
2990
2995
3000
3005
3010
3015
3020
3025
3030
3035
3040
3045
3050
3055
3060
3065
3070
3075
3080
3085
3090
3095
3100
3105
3110
3115
3120
3125
3130
3135
3140
3145
3150
3155
3160
3165
3170
3175
3180
3185
3190
3195
3200
3205
3210
3215
3220
3225
3230
3235
3240
3245
3250
3255
3260
3265
3270
3275
3280
3285
3290
3295
3300
3305
3310
3315
3320
3325
3330
3335
3340
3345
3350
3355
3360
3365
3370
3375
3380
3385
3390
3395
3400
3405
3410
3415
3420
3425
3430
3435
3440
3445
3450
3455
3460
3465
3470
3475
3480
3485
3490
3495
3500
3505
3510
3515
3520
3525
3530
3535
3540
3545
3550
3555
3560
3565
3570
3575
3580
3585
3590
3595
3600
3605
3610
3615
3620
3625
3630
3635
3640
3645
3650
3655
3660
3665
3670
3675
3680
3685
3690
3695
3700
3705
3710
3715
3720
3725
3730
3735
3740
3745
3750
3755
3760
3765
3770
3775
3780
3785
3790
3795
3800
3805
3810
3815
3820
3825
3830
3835
3840
3845
3850
3855
3860
3865
3870
3875
3880
3885
3890
3895
3900
3905
3910
3915
3920
3925
3930
3935
3940
3945
3950
3955
3960
3965
3970
3975
3980
3985
3990
3995
4000
4005
4010
4015
4020
4025
4030
4035
4040
4045
4050
4055
4060
4065
4070
4075
4080
4085
4090
4095
4100
4105
4110
4115
4120
4125
4130
4135
4140
4145
4150
4155
4160
4165
4170
4175
4180
4185
4190
4195
4200
4205
4210
4215
4220
4225
4230
4235
4240
4245
4250
4255
4260
4265
4270
4275
4280
4285
4290
4295
4300
4305
4310
4315
4320
4325
4330
4335
4340
4345
4350
4355
4360
4365
4370
4375
4380
4385
4390
4395
4400
4405
4410
4415
4420
4425
4430
4435
4440
4445
4450
4455
4460
4465
4470
4475
4480
4485
4490
4495
4500
4505
4510
4515
4520
4525
4530
4535
4540
4545
4550
4555
4560
4565
4570
4575
4580
4585
4590
4595
4600
4605
4610
4615
4620
4625
4630
4635
4640
4645
4650
4655
4660
4665
4670
4675
4680
4685
4690
4695
4700
4705
4710
4715
4720
4725
4730
4735
4740
4745
4750
4755
4760
4765
4770
4775
4780
4785
4790
4795
4800
4805
4810
4815
4820
4825
4830
4835
4840
4845
4850
4855
4860
4865
4870
4875
4880
4885
4890
4895
4900
4905
4910
4915
4920
4925
4930
4935
4940
4945
4950
4955
4960
4965
4970
4975
4980
4985
4990
4995
5000
5005
5010
5015
5020
5025
5030
5035
5040
5045
5050
5055
5060
5065
5070
5075
5080
5085
5090
5095
5100
5105
5110
5115
5120
5125
5130
5135
5140
5145
5150
5155
5160
5165
5170
5175
5180
5185
5190
5195
5200
5205
5210
5215
5220
5225
5230
5235
5240
5245
5250
5255
5260
5265
5270
5275
5280
5285
5290
5295
5300
5305
5310
5315
5320
5325
5330
5335
5340
5345
5350
5355
5360
5365
5370
5375
5380
5385
5390
5395
5400
5405
5410
5415
5420
5425
5430
5435
5440
5445
5450
5455
5460
5465
5470
5475
5480
5485
5490
5495
5500
5505
5510
5515
5520
5525
5530
5535
5540
5545
5550
5555
5560
5565
5570
5575
5580
5585
5590
5595
5600
5605
5610
5615
5620
5625
5630
5635
5640
5645
5650
5655
5660
5665
5670
5675
5680
5685
5690
5695
5700
5705
5710
5715
5720
5725
5730
5735
5740
5745
5750
5755
5760
5765
5770
5775
5780
5785
5790
5795
5800
5805
5810
5815
5820
5825
5830
5835
5840
5845
5850
5855
5860
5865
5870
5875
5880
5885
5890
5895
5900
5905
5910
5915
5920
5925
5930
5935
5940
5945
5950
5955
5960
5965
5970
5975
5980
5985
5990
5995
6000
6005
6010
6015
6020
6025
6030
6035
6040
6045
6050
6055
6060
6065
6070
6075
6080
6085
6090
6095
6100
6105
6110
6115
6120
6125
6130
6135
6140
6145
6150
6155
6160
6165
6170
6175
6180
6185
6190
6195
6200
6205
6210
6215
6220
6225
6230
6235
6240
6245
6250
6255
6260
6265
6270
6275
6280
6285
6290
6295
6300
6305
6310
6315
6320
6325
6330
6335
6340
6345
6350
6355
6360
6365
6370
6375
6380
6385
6390
6395
6400
6405
6410
6415
6420
6425
6430
6435
6440
6445
6450
6455
6460
6465
6470
6475
6480
6485
6490
6495
6500
6505
6510
6515
6520
6525
6530
6535
6540
6545
6550
6555
6560
6565
6570
6575
6580
6585
6590
6595
6600
6605
6610
6615
6620
6625
6630
6635
6640
6645
6650
6655
6660
6665
6670
6675
6680
6685
6690
6695
6700
6705
6710
6715
6720
6725
6730
6735
6740
6745
6750
6755
6760
6765
6770
6775
6780
6785
6790
6795
6800
6805
6810
6815
6820
6825
6830
6835
6840
6845
6850
6855
6860
6865
6870
6875
6880
6885
6890
6895
6900
6905
6910
6915
6920
6925
6930
6935
6940
6945
6950
6955
6960
6965
6970
6975
6980
6985
6990
6995
7000
7005
7010
7015
7020
7025
7030
7035
7040
7045
7050
7055
7060
7065
7070
7075
7080
7085
7090
7095
7100
7105
7110
7115
7120
7125
7130
7135
7140
7145
7150
7155
7160
7165
7170
7175
7180
7185
7190
7195
7200
7205
7210
7215
7220
7225
7230
7235
7240
7245
7250
7255
7260
7265
7270
7275
7280
7285
7290
7295
7300
7305
7310
7315
7320
7325
7330
7335
7340
7345
7350
7355
7360
7365
7370
7375
7380
7385
7390
7395
7400
7405
7410
7415
7420
7425
7430
7435
7440
7445
7450
7455
7460
7465
7470
7475
7480
7485
7490
7495
7500
7505
7510
7515
7520
7525
7530
7535
7540
7545
7550
7555
7560
7565
7570
7575
7580
7585
7590
7595
7600
7605
7610
7615
7620
7625
7630
7635
7640
7645
7650
7655
7660
7665
7670
7675
7680
7685
7690
7695
7700
7705
7710
7715
7720
7725
7730
7735
7740
7745
7750
7755
7760
7765
7770
7775
7780
7785
7790
7795
7800
7805
7810
7815
7820
7825
7830
7835
7840
7845
7850
7855
7860
7865
7870
7875
7880
7885
7890
7895
7900
7905
7910
7915
7920
7925
7930
7935
7940
7945
7950
7955
7960
7965
7970
7975
7980
7985
7990
7995
8000
8005
8010
8015
8020
8025
8030
8035
8040
8045
8050
8055
8060
8065
8070
8075
8080
8085
8090
8095
8100
8105
8110
8115
8120
8125
8130
8135
8140
8145
8150
8155
8160
8165
8170
8175
8180
8185
8190
8195
8200
8205
8210
8215
8220
8225
8230
8235
8240
8245
8250
8255
8260
8265
8270
8275
8280
8285
8290
8295
8300
8305
8310
8315
8320
8325
8330
8335
8340
8345
8350
8355
8360
8365
8370
8375
8380
8385
8390
8395
8400
8405
8410
8415
8420
8425
8430
8435
8440
8445
8450
8455
8460
8465
8470
8475
8480
8485
8490
8495
8500
8505
8510
8515
8520
8525
8530
8535
8540
8545
8550
8555
8560
8565
8570
8575
8580
8585
8590
8595
8600
8605
8610
8615
8620
8625
8630
8635
8640
8645
8650
8655
8660
8665
8670
8675
8680
8685
8690
8695
8700
8705
8710
8715
8720
8725
8730
8735
8740
8745
8750
8755
8760
8765
8770
8775
8780
8785
8790
8795
8800
8805
8810
8815
8820
8825
8830
8835
8840
8845
8850
8855
8860
8865
8870
8875
8880
8885
8890
8895
8900
8905
8910
8915
8920
8925
8930
8935
8940
8945
8950
8955
8960
8965
8970
8975
8980
8985
8990
8995
9000
9005
9010
9015
9020
9025
9030
9035
9040
9045
9050
9055
9060
9065
9070
9075
9080
9085
9090
9095
9100
9105
9110
9115
9120
9125
9130
9135
9140
9145
9150
9155
9160
9165
9170
9175
9180
9185
9190
9195
9200
9205
9210
9215
9220
9225
9230
9235
9240
9245
9250
9255
9260
9265
9270
9275
9280
9285
9290
9295
9300
9305
9310
9315
9320
9325
9330
9335
9340
9345
9350
9355
9360
9365
9370
9375
9380
9385
9390
9395
9400
9405
9410
9415
9420
9425
9430
9435
9440
9445
9450
9455
9460
9465
9470
9475
9480
9485
9490
9495
9500
9505
9510
9515
9520
9525
9530
9535
9540
9545
9550
9555
9560
9565
9570
9575
9580
9585
9590
9595
9600
9605
9610
9615
9620
9625
9630
9635
9640
9645
9650
9655
9660
9665
9670
9675
9680
9685
9690
9695
9700
9705
9710
9715
9720
9725
9730
9735
9740
9745
9750
9755
9760
9765
9770
9775
9780
9785
9790
9795
9800
9805
9810
9815
9820
9825
9830
9835
9840
9845
9850
9855
9860
9865
9870
9875
9880
9885
9890
9895
9900
9905
9910
9915
9920
9925
9930
9935
9940
9945
9950
9955
9960
9965
9970
9975
9980
9985
9990
9995
10000
10005
10010
10015
10020
10025
10030
10035
10040
10045
10050
10055
10060
10065
10070
10075
10080
10085
10090
10095
10100
10105
10110
10115
10120
10125
10130
10135
10140
10145
10150
10155
10160
10165
10170
10175
10180
10185
10190
10195
10200
10205
10210
10215
10220
10225
10230
10235
10240
10245
10250
10255
1

1
The primary problem occurring in this situation is that the data throughput from the data source, such as a file on a hard disk drive or a master compact digital disk, to the write head of the CD-R drive is interrupted during the copy process. Many times when
5 this occurs the data buffer to the write head of the CD-R drive is exhausted and null data is written onto the CD-R disk, making the CD-R disk irrevocably defective.

10 The frequency of such a defective CD-R disk write increases at least linearly as the drive speed of the CD-R writing head is increased. The industry standard speed is approximately 150K Bytes per second. Some CD-R disk drives can write data at four times this standard speed, but while this increased speed lowers the total copying time, the frequency of defective CD-R disk writes increases as data throughput from the data source is increased.

15 An additional problem in a volume copying process is the necessity for direct human supervision to prepare CD-R disks for copying, remove the disks from the CD-R disk writer once copying is complete, and then prepare the disks for inspection to ensure no defective CD-R disks are retained in the completed set of copies.
20 Aside from the tedium involved that may indirectly add errors, requiring human attention in this process adds a significant labor cost that is added to the end-user price.

The copy speed versus accuracy problem described above is solved when the CD-R disk writer is configured to concurrently copy
25 the data onto multiple CD-R disks. For example, the total copy time for two CD-R disk drives concurrently copying data at 150K

Bytes per second is the same as one CD-R disk drive serially copying two CD-R disks at 300K Bytes per second, and the frequency of disk write errors using the concurrent disk drives is approximately half that of the serial disk drive.

5 This system uses the concurrent copying method described above and also eliminates the necessity of direct human supervision of the copy process through the unique circular arrangement of CD-R disk spindle members around a pivotal transport tower containing a disk pickup head that lifts a blank disk from a disk spindle member and transports the disk to one of the available stacked CD-R disk drives. After the recording process is complete the disk pickup head retrieves and transports the burned CD-R disk copy to a specified disk spindle member for copied disks.

10
15
20 The electrical and physical configuration of this system provides several additional benefits to users. The semi-circular arrangement of disk spindle members around the pivotal transport tower minimizes the number of moving parts needed to construct the disk transport assembly. A system having more disk spindle members can be constructed by increasing the radius of the circle formed by the disk spindle members. Similarly, the arrangement of two stacked sets of recordable disk drives allows for a scaleable design permitting the user to make low-cost upgrades.

25 Prior disk copy methods only provided for lineal copying of a single source disk. The configuration of this system allows for several master compact disks to be transportable by the disk hub to a selected disk read head so that the copy process from the master

compact disks is a random access process.

Yet another benefit provided by this system is the system's ability to test burned CD-R disks for disk write errors, and through use of the pivotal transport tower, eject a defective CD-R disk isolating the defective CD-R disks from the set of properly
5 burned CD-R disks.

SUMMARY OF THE INVENTION

The programmable, automatic compact disk duplication system of this invention includes a copy unit, a host computer, and computer software. The host computer and computer software provide an interface allowing the user to pre-program the copy unit to perform a completely unattended copy and data verification operation upon blank CD-R disks pre-loaded in the copy unit.

While not required for operation of the duplication system, it is preferred that the duplication system use an IBM PC-clone running a DOS or Windows operating system so that users need not purchase additional computer hardware to operate the duplication system. Hardware-specific computer components necessary to describe the duplication system will reference IBM PC and Windows specifications; however the duplication system is not intended to remain limited to these specifications and a designer skilled in the art would be able to translate these specifications into hardware and software equivalents for systems using Apple, UNIX, or IBM protocols.

The Copy Unit

The copy unit has a main copy assembly with an external vacuum pump. The primary components inside a housing for the main copy assembly include a microprocessor, a set of disk spindle members, a pivotal transport tower, a data transfer unit, a vacuum regulator and an air filtration unit. The external vacuum pump is connected to the vacuum regulator by an air hose leading to a disk suction pickup unit affixed to the pivotal transport tower.

1. The Microprocessor

The microprocessor is an internal control unit for the copy unit and is electrically connected to the host computer, the pivotal transport tower, and all CD-R disk drive heads. In the preferred embodiment, a 8031 microprocessor is used, but any 8-bit microprocessor capable of processing a command set of about 20 commands could be used.

The microprocessor receives user input generated by the software that is executed on the user's host computer. The computer software processes the user input into a set of ASCII commands sent to microprocessor via an RS-232 interface. The ASCII command set used is a variant of the Trace Mountain protocol that is often used to interface software to hardware copy devices. Commands sent by the computer software to the microprocessor consist of one letter or one letter and two digits.

Once the microprocessor is sent a command by the host computer, the microprocessor parses the command and sends an electrical signal to the pivotal transport tower.

Depending on the command sent by the computer software, the microprocessor will transmit back to the computer software a "ready" indication, an echo of the command received, or a status indication that command received was successfully or unsuccessfully executed. This status indication is then interpreted by the computer software into user readable information displayed on the host computer's video output display.

2. The Disk Spindle Members

A set of disk spindle members are located on a front horizontal deck of the copy unit. The bottom of each disk spindle member is affixed to the horizontal deck of the copy unit and projects vertically from the deck. The diameter of each disk spindle member is slightly smaller than the center hole of a CD-R disk, allowing for free vertical movement of the CD-R disk when the disk is located on the disk spindle member.

The disk spindle members are affixed to the horizontal deck of the copy unit along an arc of a circle around the axis of the pivotal transport tower. It is expected that at least two disk spindle members are affixed to the horizontal deck of the copy unit, allowing one disk spindle member to hold blank CD-R disks and the other disk spindle member to hold burned CD-R disks. The radius of the circle is selected such that CD-R disks located on adjoining spindles do not touch each other.

3. The Pivotal Transport Tower

The pivotal transport tower is centrally located in the copy unit at the radial center of the arc formed by the disk spindle members. The pivotal transport tower is cylindrically shaped, with a vertically displaceable arm projecting radially from the pivotal transport tower. Inside the pivotal transport tower is an axle along the vertical axis of the pivotal transport tower. The axle is affixed to the base of the pivotal transport tower. Connected to the axle is a first drive motor capable of pivoting the pivotal transport tower about its vertical axis. Control of the first

drive motor is also supplied from electrical signals sent by the microprocessor.

An arm for a disk pickup head projects radially from the pivotal transport tower. One end of the arm is connected to a belt running vertically along the inside of the pivotal transport tower. The bottom of the belt travels around a set of gears that are connected to a second drive motor. When the second drive motor rotates the belt, the arm is raised or lowered depending on the direction of rotation of the belt.

The other end of the arm supports a disk pickup head which has a disk suction pickup unit. The disk suction pickup unit is triangle-shaped and has a circular aperture located at its apex. The diameter of the aperture is slightly wider than the diameter of a disk spindle member. Located on the underside of the disk suction pickup unit near each vertice of the disk suction pickup unit is one suction member and one rubber stopper member. A sensor also protrudes downward from the underside of the disk suction pickup unit and relays an electrical signal back to the microprocessor indicating the presence of a target disk near the disk suction pickup unit.

Additionally, during operation of the disk suction pickup unit, RAM memory located in the microprocessor or electrically connected to the microprocessor retains data for each disk spindle member corresponding to the approximate vertical distance the disk suction unit must travel before retrieving a blank CD-R disk or placing a burned CD-R disk back onto the disk spindle member.

When the disk suction pickup unit is operated, the suction members draw in air, causing the target disk to adhere to the suction members, holding the target disk horizontally against the rubber stopper members.

5 The size and placement of the arm and the disk suction pickup unit are chosen so that during a disk pick-up or drop-down operation the selected disk spindle member passes through the aperture as the arm lowers below the top of the selected disk spindle member.

10 In a typical disk transport operation, the microprocessor issues a sequential set of electrical signals that are translated into a sequential set of operations performed by the second drive motor, the first drive motor, and the disk suction pickup unit. For example, the following sequential operations controlled by the
15 microprocessor occur when the copy unit transfers the top CD-R disk from a stack of CD-R disks surrounding a selected spindle to the data transfer unit:

the first drive motor raises the disk suction pickup unit to a height such that all components of the disk suction pickup unit
20 are above the top of all disk spindle members;

the second drive motor pivots the pivotal transport tower to position the disk suction pickup unit over the selected disk spindle member, placing the aperture directly above the disk spindle member;

25 the first drive motor lowers the disk suction pickup unit along the disk spindle member until the suction members make contact with

the CD-R disk;

the suction members engage and hold the CD-R disk;

the first drive motor raises the disk suction pickup unit along the
disk spindle member until the CD-R disk held by the suction
5 members is above the top of all disk spindle members;

the second drive motor pivots the pivotal transport tower,
positioning the CD-R disk held by the suction members for
transfer into the data transfer unit.

4. The Data Transfer Unit

10 The data transfer unit comprises two stacked disk drive
receptacle members and a variable number of stacked recordable disk
drive members. The two stacked disk drive receptacle members are
affixed on opposite sides of the back horizontal deck of the copy
unit and positioned along the arc of the circle formed by the disk
15 spindle members at a distance greater than the diameter of a CD-R
disk. Each stacked recordable disk drive member fits in a slotted
receptacle member located in one of the two stacked disk drive
receptacle members and is positioned on the perimeter of the circle
formed by the disk spindle members, making each stacked recordable
20 disk drive member capable of receiving a disk transported by the
arm.

Each stacked recordable disk drive member sends and receives
binary data with the computer software via a standard 50-pin SCSI
connection between the stacked recordable disk drive member and the
25 host computer. Manual loading and unloading of a CD-R disk in
every stacked recordable disk drive member is accomplished through

an input-output tray member that is a standard feature of recordable and read-only disk drives; control of the input-output tray member is also communicated through each stacked recordable disk drive member's SCSI connection.

5 In the preferred embodiment, the top of the main copy assembly located in the void between the two stacked recordable disk drive members has a disk reject slide that is constructed at a downward angle, allowing the combination of the pivotal transport tower and the two stacked recordable disk drive members to eject defective
10 CD-R disks out of the main copy assembly by dropping them onto the disk reject slide. Gravity pulls the defective CD-R disk downward along disk reject slide and the defective CD-R disk leaves the main copy assembly.

15 An additional hardware item easily added to the data transfer unit is a standard disk printer that affixes printed labels or imprints the top side of any burned CD-R disk. In this configuration, the disk printer is placed along the rear wall of the copy unit so that the input/output loading tray of the disk printer opens into the void between the two stacked recordable disk
20 drive members.

5. The Vacuum Regulator and the External Vacuum Pump

The vacuum regulator is housed inside the main copy assembly and is connected to the suction members by a set of internal air hose members. An external air hose connects the vacuum regulator
25 to the external vacuum pump that is physically separated from the main copy assembly in order to reduce vibrations inside the main

copy assembly. The vacuum regulator maintains a constant pressure vacuum and is controlled by the microprocessor.

6. The Air Filtration Unit

The air filtration unit creates a flow of filtered air through the inside of the main copy assembly to significantly reduce CD-R disk read or write errors caused by dust or other contaminants that may be in the air surrounding the duplication system. The air filtration unit comprises a set of electric fan members, an air filter, a set of outflow vents, and an outer cover covering the outside of the main copy assembly. The electric fan members are positioned along the back vertical face of the main copy assembly and when operated draw air into the inside of the main copy assembly.

Positioned along the inside vertical face of the main copy assembly is an air filter that filters air drawn in by the electric fan members before it can circulate through the inside of the main copy assembly. The filtered air then exits the main copy assembly through the outflow vents.

The Host Computer

No particular type of host computer is necessary to support the copy unit and the computer software. A conventional personal computer equipped with a SCSI throughput interface and a hard disk drive capable of retaining an image of the master data will suffice.

The Computer Software

5

In the preferred embodiment, the computer software necessary to direct the data transfer operations is written in the "C" programming language running under a Windows operating system. However, the computer software could be written using any computer language and operating system compatible with the computer used, provided Trace Mountain - type protocols can be sent to the copy unit via an RS-232 or SCSI connection between the host computer and the copy unit.

10

These and other features will become apparent from a consideration of the Detailed Description of the Preferred Embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic view of the compact disk duplication system of this invention with a perspective view of the copy unit.

Fig. 2 is a side view of the main copy assembly with the clear outer cover removed.

Fig. 3 is an enlarged side view of the pivotal transport tower.

Figs. 4A-D are segments of a continuing flowchart diagram of the procedures performed in a disk copy operation.

Figs. 5A and 5B are schematic representations of an auxilliary print application unit.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Fig. 1, the programmable automatic compact disk duplication system of this invention is designated generally by the reference numeral 10. The duplication system 10 includes a host computer 12, shown schematically, connected to a copy unit 20. The host computer 12 comprises a programmable computer that includes computer software for providing a user interface for operating the copying process of the copy unit 20. It is to be understood that the host computer may be incorporated into the copy unit 20 with the copy unit having a keyboard or other input device such as a control panel for managing the operation of the copy unit 20.

As shown in Fig. 2, the copy unit 20 includes an internal microprocessor 24 that is electrically connected to the host computer 12 for controlling the electromechanical operations of the copy unit 20. The copy unit 20 is constructed with a housing 14 having a deck 16 housing the electronics and drive assemblies, and a cabinet 18 housing the copying and printing components.

The deck 16 has a base platform 22 for a pivotal transport tower 58 and a series of disk spindle members 52 disposed in an arcuate arrangement around the transport tower 58. A removable transparent cover 59, shown in Fig. 2, encloses the tower 58 and disk spindle members 52 to protect the system from dust contamination during operation and allow for functioning of an air filtration circuit as later described.

In the preferred embodiment of Figs. 1 and 2, the copy unit 20 has four disk spindle members 52. In such a configuration two of

the disk spindle members 52 may hold blank CD-R disks, one disk spindle member designated as a master disk spindle member 52a may hold one or more master compact disks. The remaining disk spindle member is designated as a master output spindle 52b and is used to hold the master compact disks after source data has been transferred from the master disk.

The pivotal transport tower 58 is located in the center of the arc formed by the disk spindle members 52 and rotates about its longitudinal axis passing directly through the center of the arc. Attached to the pivotal transport tower 58 is an arm 56 that rotates along the arc as the pivotal transport tower 58 pivots and also travels vertically along the pivotal transport tower 58. A vertical aperture 64 having its center correspond to the arc is located on the arm 56.

As described below, the underside of the arm 56 has several components allowing the arm 56 to temporarily affix a compact disk to the underside of the arm 56 and retain the compact disk as the arm 56 travels radially or vertically. Other means including mechanical pickup mechanisms may be substituted for the preferred pneumatic unit of the described embodiment.

In Fig. 2., the arm 56 is positioned above one disk spindle member that is holding a stack of CD-R disks 50. For illustration purposes this disk spindle member is designated as the master disk spindle 52a, but it is to be understood that the physical transfer of compact disks from all disk spindle members is identical. At the base of each disk spindle member 52 is a removable spindle base

51 allowing the user to insert or remove a stack of compact disks held in place by the disk spindle member 52.

Upon activation of a motor housed inside the copy unit 20, the arm 56 descends with the disk spindle member 52 passing through the aperture 64, until a sensor 66 located on the underside of the arm 56 detects the presence of a compact disk 50. Then suction supplied by disk suction pickup unit 54 affixes the compact disk 50 to the underside of the arm 56, the suction remaining constant until the compact disk 50 is transported to its resting place. The suction then terminates and the compact disk 50 is released from the arm 56 by gravitational force.

Located opposite the disk spindle members 52 are two sets of stacked disk drive receptacle members 82. Each stacked disk drive receptacle member 82 accepts a standard stacked recordable disk drive member 84. Each stacked recordable disk drive member 84 has an autoloading tray 85 that, when fully opened, positions the center of a compact disk 87 along the radius arc defined by the arc of the disk spindle members 52. This geometrical configuration allows the arm 56 to place and retrieve compact disks in any of the stacked recordable disk drive members in the same manner as the arm 56 places and retrieves compact disks on the disk spindle members 52.

For clarity, in Fig. 2 the components located inside the main copy assembly 20 are designated schematically by hatched rectangles, and where necessary, detailed drawings of these components are shown in other figures.

The deck 22 of the main copy assembly 20 is box-shaped, having a flat rectangular bottom and sides perpendicular to the bottom. Inside the deck 22 is a microprocessor 24 that is connected by an electrical connection 26 to an RS-232 port 28. A stepper motor 32 receives signals sent by the microprocessor 24 through an electrical connection 30. A shaft 34 leaving the stepper motor 32 connects to a gearing unit 36. Connected to the gearing unit 36 is an axle 38 that rotates when the stepper motor 32 is engaged. An external air hose 74 enters an opening in the deck 22 and terminates at a connection to a vacuum regulator 72.

A female power receptacle 40 allows for attachment of an electrical cord (not shown) providing standard 120V AC to a transformer 44 through an electrical line 42. As detailed below, the transformer 44 supplies power to components throughout the main copy assembly 20; inside the deck 22, the microprocessor 24 receives power through electrical line 46 and the stepper motor 36 receives power through electrical line 48.

Compact disks 50 sit on the top of the deck 22 and are held in place by one of the disk spindle members 52 until retained by the disk suction pickup unit 54 that is located on the underside of the arm 56. An aperture 64 through the arm 56 allows the disk suction pickup unit 54 to travel downward with the selected disk spindle member 52 passing through the aperture 64 as the disk suction pickup unit 54 travels downward below the vertical height of the top of the disk spindle member 52.

The disk suction pickup unit 54 has suction members 60

creating sufficient suction to hold one disk against the rubber stopper members 62 that keep the disk in a horizontal position. The vacuum hose 70 is positioned along the inside wall of the pivotal transport tower 58 and one end is connected to the vacuum regulator 72. The other end of the vacuum hose 70 has three connector members 71 allowing the air flow to branch into each attached suction member 60. A sensor 66 is attached to the disk suction pickup unit 54 and sends a signal back to the microprocessor indicating the presence of a disk near the disk suction pickup unit 54.

The arm 56 is affixed to the pivotal transport tower 58 and rotation of the arm 56 is accomplished through pivoting of the pivotal transport tower 58. The other end of the arm 56 is secured around the axle 38, allowing for radial movement of the pivotal transport tower 58 when the axle 38 rotates.

Behind the pivotal transport tower 58 is the data transfer unit, designated generally by the numeral 80. Sitting on each of the two rear corners of the deck 22 is a stacked disk drive receptacle member 82 containing slotted receptacles 83 for holding a variable number of stacked recordable disk drive members 84, allowing the user vary the total number of recordable disk drives available to burn disks. Each stacked disk drive receptacle member 82 can also hold a read-only disk drive permitting very fast transfer of data from master disks.

The stacked disk drive receptacle members 82 are placed on top of the deck 22 along the outside of the perimeter of the circle

formed by the disk spindle members 52 such that the arm 56 may transfer a disk to the space between the two stacked disk drive receptacle members 82. A disk transported to this region may then be inserted into any of the stacked recordable disk drive members 84 provided the stacked recordable disk drive members 84 have a standard motorized loading tray 85.

Located at the bottom of the region between the stacked disk drive receptacle members 82 on the top of the deck 22 is a disk reject slide 92 slanting downward out of the rear of the data transfer unit 80 that receives defective CD-R disks dropped down by the arm 56 in the region between the stacked disk drive receptacle members 82. Defective CD-R disks dropped onto disk reject slide 92 fall out of the main copy assembly 20 by gravity.

The system can also be equipped with an optional print application unit 93 that is placed behind the stacked disk drive receptacle members and loads and unloads CD-R disks in the space between the two stacked disk drive receptacle members 52 and directly above the disk reject slide 92. In this configuration, the print application unit 93 is electrically connected to the host computer 12 and imprints markings or printed labels to the top side of a burned CD-R disk.

The optional print application unit 93 is shown in Figs. 5A and 5B. The print application unit comprises an ink jet printer or a thermal printer to imprint a blank disk with markings or labels. Where disk blanks are previously printed with markings 94, such as designs 94a, and a label window 94b as shown in Fig. 5B, it is

necessary to rotate the disk or rotate the virtual bit mapping of the new marking or labels to be added, so that the new printing registers with the pre-existing printing. It is common, for example, for blank CD-R disks to have company names and logo's pre-printed by a silk screening process by the disk supplier or an intermediary. New material may comprise titles or added decorative work requiring registration coordination. Since disks are symmetrical and consistently positioned, proper angular orientation is all that is required to achieve registration.

In Fig 5B, a disk 95 is positioned on retractable printer tray 96 and is preprinted with an angular registration mark, such as dot mark 94C adjacent the hub hole. A digital camera 97 retrieves a digital image of at least the center portion of the disk, and the limited field area where the mark must necessarily be found is analyzed by a software program to locate the registration dot mark 94c and to determine its angular orientation. The virtual image in memory is rotated accordingly before or while the reoriented bit map is printed to disk.

By use of a simple registration mark positioned in a predetermined annular area, image analysis is greatly simplified and equipment costs are reduced. Furthermore, by consistent placement of the mark with respect to the angular orientation of the original printing, an initial run for image loading of the original printing is avoided.

When the print application unit is a thermal printer, the newly printed image or markings requires little or no time to cure

before the disk can be robotically handled and moved to the output spindle. Ink jet printing requires a bit longer for the deposited ink to dry before handling. Ordinarily, with simple labels and text titles, the limited ink deposit dries during the time another
5 disk is being recorded in a single station duplication system. In a multiple station system as is presently disclosed, accelerated drying is preferred to insure proper drying.

10 In the duplication system of this invention, accelerated drying for ink jet printing is aided by an elongated thermal element 98 at the lower edge of the partially shrouded opening 99 of the application unit 93. Heated air passing to an external vent member 90a at the back top of the print unit 93 accelerates the drying of the ink. The system is preferably programmed to allow
15 the disk 95 to remain in the extended tray 96 as long as possible after printing before pickup by the pickup unit 54 on the transport tower 58 and deposit on the output spindle.

20 Located at the rear of the stacked disk drive receptacle members 82 are one or more electric fan members 86 that draw in air to ventilate the main copy assembly 20 preventing heat build-up created by the stacked recordable disk drive members 84. An air filter 88 is positioned on the interior rear wall of the data transfer unit 80 that filters the air drawn in by the electric fan members 86 before the air travels through the interior of the main copy assembly 20. The filtered air then exits the interior of the
25 main copy assembly 20 through vent members 90b located on the deck 22.

In systems having the optional print application unit 93, the filtered and warmed air is passed through the printer to exit the auxiliary vent member 90a as described. The circulated air aids in drying of the printed disk deposited on the top of the output spindle as well.

In a system having a mechanical pickup unit that engages the disk hole and does not contact the newly printed surface, the thermal element and programmed delay of pickup may be unnecessary, and drying accomplished by the component warmed air circulated over the printed disk when on the printer tray and on the output spindle.

Referring to Fig. 3, a side view of the mechanical linkages that allow for movement of the pivotal transport tower is shown. The pivotal transport tower 58 has a cylindrical outer shell 100 that is oriented vertically and sits on a circular rotating base 102. Affixed to the bottom of the center of the rotating base 102 is an axle 38 that allows for radial movement of the pivotal transport tower 58.

The axle 104 passes through an aperture 106 in the top of the base platform 22 and also passes through an aperture 108 in a horizontal frame member 110. The end of the axle 38 is affixed to the center of a pulley wheel member 112. Rotation of the pulley wheel member 112 is controlled by a belt 114 surrounding a second pulley wheel member 116.

Affixed to the center of the second pulley wheel member 116 is one end of an axle 118. The other end of the axle 118 is affixed

to the center of a third pulley wheel member 120. Rotation of the third pulley wheel member 120 is controlled by a belt 122 that also surrounds the perimeter of a fourth pulley wheel member 124.

Rotation of the fourth pulley wheel member 124 is controlled by one end of a shaft 34 that is affixed to the center of the fourth pulley wheel 124. The other end of the axle 34 is connected to the stepper motor 32 that is the source of all rotation of the pivotal transport tower 58. Attached to the frame 110 is an encoder sensor 131 that is electrically connected to the stepper motor 32 and prevents over-rotation of the pivotal transport tower 58.

An aperture 130 through the cylindrical outer shell 100 allows for movement of the arm 56 along the vertical axis of the pivotal transport tower 58. The back 134 of the arm 56 is affixed to a belt 132 that travels vertically and raises or lowers the arm 56 as the belt 132 moves.

The top end of the belt 132 travels around a pulley wheel member 136. The outer side of the rear face of the belt 132 makes contact with a pulley wheel member 138 that makes the rear face of the belt 132 travel towards the rear of the pivotal transport tower 58.

The inner side of the rear face of the belt 132 then travels around a pulley wheel member 140 that is connected to a stepper motor 142 that rotates the pulley wheel member 140 when the stepper motor 142 is engaged.

The inner side of the rear face of the belt 132 then travels

around a pulley wheel member 144 that changes the direction of the travel of the belt 132 back to vertical.

5 The stepper motor 142 is electrically connected to a limit sensor 146 placed above the pulley wheel member 136 and disengages the stepper motor 142 when the limit sensor 146 detects the presence of a limit flag 148 placed on the top of the arm 56.

10 One end of the air line 150 is connected to a vacuum line valve 152 that controls the flow of air through the air line 150. The air line 150 travels through the inside of the pivotal transport tower 58 and through the arm 56 and the disk suction pickup unit 54, with openings connected to each disk suction member 60.

15 Referring to Figs. 4A through 4D, a flowchart of the procedures performed in a disk copy operation, are shown. The logic necessary to perform a disk copy operation is programmed into the computer software on the host computer and programmed into the microprocessor located inside the copy unit.

20 A user begins a disk copy operation by loading master disks on a disk spindle member designated as the master disk spindle member 52a and loading blank recordable disks onto other disk spindle members 52. The user then supplies power to the copy unit 20 and starts the computer software located in the host computer 12. These initialization subprocedures are indicated in item step 200. A display 13 connected to the host computer 12 then prompts the user for information regarding the selection of the master disk spindle 52a and the location of the blank CD-R disks. The user

25

also selects a master output spindle 52b that will hold master disks after the data transfer from each master disk to the host computer 12. The user also supplies instructions indicating the tracks on the master disks to be copied. This operation is indicated in item step 210.

When first powered on, the internal microprocessor 24 sends electrical signals to test the operation of the arm 56, as indicated in item step 220. The microprocessor 24 sends a set of flags back to the computer software to signal the status of the hardware located on the copy unit 20, as indicated in item step 230. If the computer software receives a status flag indicating hardware failure, the computer software issues a display error message for the user to decode, and the copy process is terminated, as indicated in item step 240.

If the computer software receives status flags indicating the hardware is operational, the computer software sends instructions to the microprocessor that comprise a data acquisition subprocedure. The beginning of the data acquisition subprocedure is indicated in item step 250 and comprises item steps 260 through 340.

In item step 260, the computer software checks if a disk drive on the host computer contains an image of the master data. If an image file already exists, control of the software is transferred to item step 360. Otherwise, control of the computer software is transferred to item step 270.

As indicated in item step 270, the computer software first

compares the number of disk drives to the number of master disks loaded on the master disk spindle member 53. If the number of stacked recordable disk drives 84 is greater than or equal to the number of master disks, the computer software sends a command set to the microprocessor 24 to transfer each master disk to an available stacked recordable disk drive 84, as indicated in item step 280.

The computer software then sequentially issues read commands to each stacked recordable disk drive 84 containing a master disk and transfers the source data from each master disk to the host computer 12. These commands are summarized in item step 290. Once the data transfer process is completed, the computer software sends a command set to the microprocessor to transfer each master disk back to the master output spindle 55, as indicated in item step 300, and the data acquisition subprocedure is complete.

If the number of stacked recordable disk drives 84 is less than the number of master disks, the computer software must loop through item steps 310 through 340 until all master disks have been transferred to an available stacked recordable disk drive 84.

This loop begins when the computer software sends a command set to the microprocessor 24 to transfer the maximum number of remaining uncopied master disks held by the input spindle from the master disk spindle member 52a to the stacked recordable disk drives 84, as indicated in item step 310. Then in item step 320, data is transferred from the master disks to the host computer 12 in the same manner as in item step 280.

After all data from the master disks loaded in stacked recordable disk drives 84 has been transferred to the host computer 12, the master disks are either transferred to the master output spindle 55, or are ejected onto the disk reject slide 92, as indicated in item step 330.

The computer software completes this loop as indicated in item step 340 by comparing the number of uncopied master disks with zero, and returning to the top of the loop at item step 310 if any uncopied master disks remain. Once the data acquisition subprocedure is completed, control of the computer software is transferred to the beginning of the data transfer subprocedure, indicated as item step 360.

At the beginning of the data transfer subprocedure, the computer software will, if necessary, reformat the image of the source data located on the hard drive of the host computer to ensure optimal recording speed and accuracy. This computation is indicated in item step 370. A variable containing the number of copies made is initialized to zero, as indicated in item step 380.

Item steps 390 through 430 correspond to a loop over all selected stacked recordable disk drives 84 whereby the computer software first issues commands to the microprocessor 24 to query the hardware status of each stacked recordable disk drive 84, as indicated in item step 400. The computer software will alert the user of any stacked recordable disk drive 84 that the microprocessor 24 has identified as non-operational, as indicated in step 410. Otherwise, the computer software will set a flag

indicating that the queried CD-R drive is operational, as indicated in item step 420.

Once the hardware test loop is completed, the computer software branches on a test of the number of operational stacked recordable disk drives 84, as indicated in item step 440. The computer software will exit the copy process if no stacked recordable disk drives 84 are operational, as indicated in item step 450. Otherwise, the computer software initializes to zero a variable containing the number of copies made, as indicated in item step 460.

The computer software then enters a main copy loop, indicated in item step 470, that repeats until the number of copies made equals the desired number of copies. This comparison operation is made in item step 480, and the proper termination of the copy process occurs in item step 490.

If the number of copies made is less than the number of copies desired, the computer software initializes to zero a variable containing the number of copies currently loaded in the stacked recordable disk drives 84, as indicated in item step 500. The computer software then enters an inner loop comprising item steps 510 through 580, with each cycle of the inner loop corresponding to the transfer of a blank disk to an available operational stacked recordable disk drive 84.

This inner loop begins with a comparison of the number of copies desired with the sum of the copies already made plus the number of disks loaded the current batch transfer, as indicated in

item step 520. If the sum of the copies already made plus current number of disks loaded into the stacked recordable disk drives 84 equals the number of copies desired, the inner loop terminates, as indicated in item step 530.

5 Otherwise, the computer software issues a set of commands to the microprocessor 24 to transfer a blank disk to the next available stacked recordable disk drive 84, as indicated in item step 540. The computer software then checks the status of the disk transfer, as indicated in item step 550, and will terminate or
10 otherwise commence other error handling subprocedures if the disk transfer failed, as indicated in item step 560. Otherwise, the variable containing the number of disks loaded is incremented by one, as indicated in item step 570.

15 Once the inner loop terminates at item step 580, the stacked recordable disk drives 84 have been loaded with the maximum number of blank disks, the computer software sends electrical signal instructions that activate the physical transfer of source data to each blank disk loaded in the loaded stacked recordable disk drives 84, as indicated in item step 590. The computer software then
20 examines copy status flags from each loaded stacked recordable disk drive 84, as indicated in item step 600, and issues a command set to the microprocessor 24 to discard burned CD-R disks corresponding to any bad copy status flags, as indicated in item step 610.

25 In item step 620, the user can optionally configure the computer software to perform a data verification on each burned disk that is currently loaded in the stacked recordable disk drives

84. In this subprocedure, the computer software would direct each stacked recordable disk drive 84 to read the data off the burned disk and compare it to the source data residing on the hard drive of the host computer 12. Defective burned CD-R disks would be ejected from the copy unit in the same manner as in item step 610.

In item step 630, the user can optionally configure the copy unit to include a print application unit that imprints or labels the top of each burned CD-R disk with information transferred from the computer software. In this subprocedure, the burned CD-R disk is ejected from its stacked recordable disk drive 84 and vertically transported by the disk suction pickup unit 54 and then loaded into the input tray 96 of the print application unit 93.

The printer has internal software to effect the printing tasks including optional analysis of a preprinted disk and orientation of a virtual print image under command of the software of the copy unit. If optional print step is affirmative the print unit is ordered to extend the print tray 96 at step 632. The copy unit loads a correctly burned disk at step 633. If the print image must be oriented to register with a preprinting of the disk at option step 634, then the photo image step 635 takes an image of the disk which is analyzed at step 636 by the software to locate the orientation mark and calculate the angular orientation of the to-be printed image for proper registration at step 637. This accomplished, or if not required, the print disk step 638 is executed. After printing, the tray is extended at step 639, and a delay pickup decision at step 641 is made. If pickup is to be

delayed, for example, to allow ink jet printing ink an extended opportunity to dry, the pickup is delayed at step 643 is made. If no, or after delay the print option loop returns to the main path at step 640 where the disk is eventually transferred to the output spindle or spindles.

The variable containing the number of loaded stacked recordable disk drives is reset to equal the number of properly burned CD-R disks, as indicated in item step 640. The total number of copies made is then incremented by the number of properly burned CD-R disks, as indicated in step 650. The computer software then issues a command set to the microprocessor 24 directing the transfer of the properly burned CD-R disks to one of the designated output spindles, as indicated in step 660. The computer software receives a status signal from the microprocessor 24 indicating whether the transfer occurred properly, as indicated in item step 670, and will display an error message and exit if a disk transfer failed, as indicated in step 680. Otherwise, control of the computer software drops to the bottom of the main loop 690 and then returns to the top of the main loop at item step 470.

While, in the foregoing, embodiments of the present invention have been set forth in considerable detail for the purposes of making a complete disclosure of the invention, it may be apparent to those of skill in the art that numerous changes may be made in such detail without departing from the spirit and principles of the invention.

WHAT IS CLAIMED

1. A system for the duplication of data onto compact disks, the system comprising:

a copy unit, comprising:

at least one set of multiple stacked recordable disk drives;

a pivotal transport tower;

a set of disk retainer members, arranged in a symmetric circular pattern around the pivotal transport tower, wherein the disk retainer members maintain the order and placement of a stack of compact disks during the copy operations, wherein a disk stack in any of the disk retainer members in the set has a top with a top disk;

an arm, connected to the pivotal transport tower, the arm having a disk engagement and lift mechanism that cooperates with the pivotal transport tower to engage, lift and pivot a top disk located on the top of a stack held in place by one disk retainer member to any stacked recordable disk drive member, wherein the disk engagement and lift mechanism and pivotal transport tower also cooperate to engage, lift and pivot a disk located in any one of the stacked recordable disk drives to the top of any stack held in place by one of the disk retainer members.

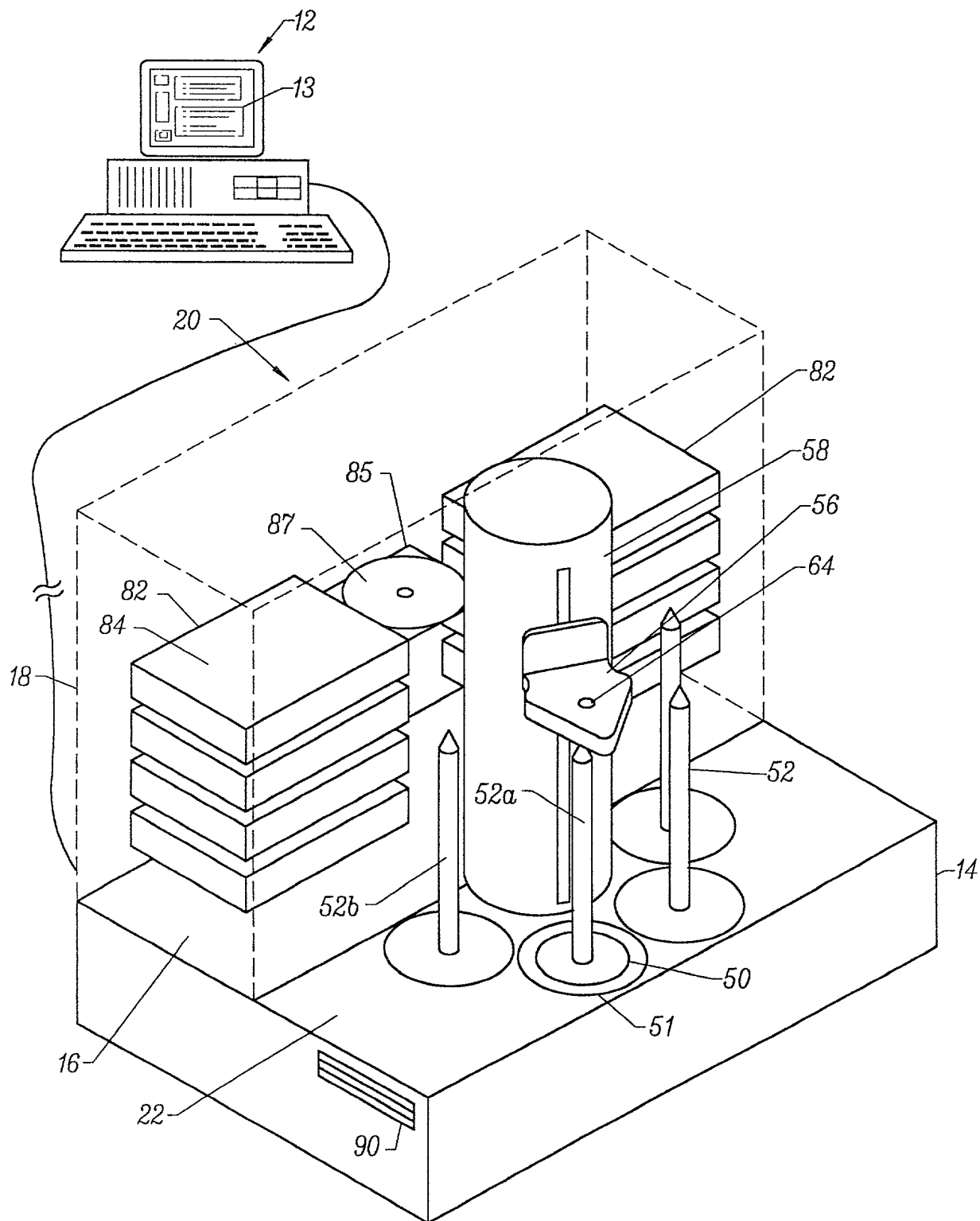


FIG. 1

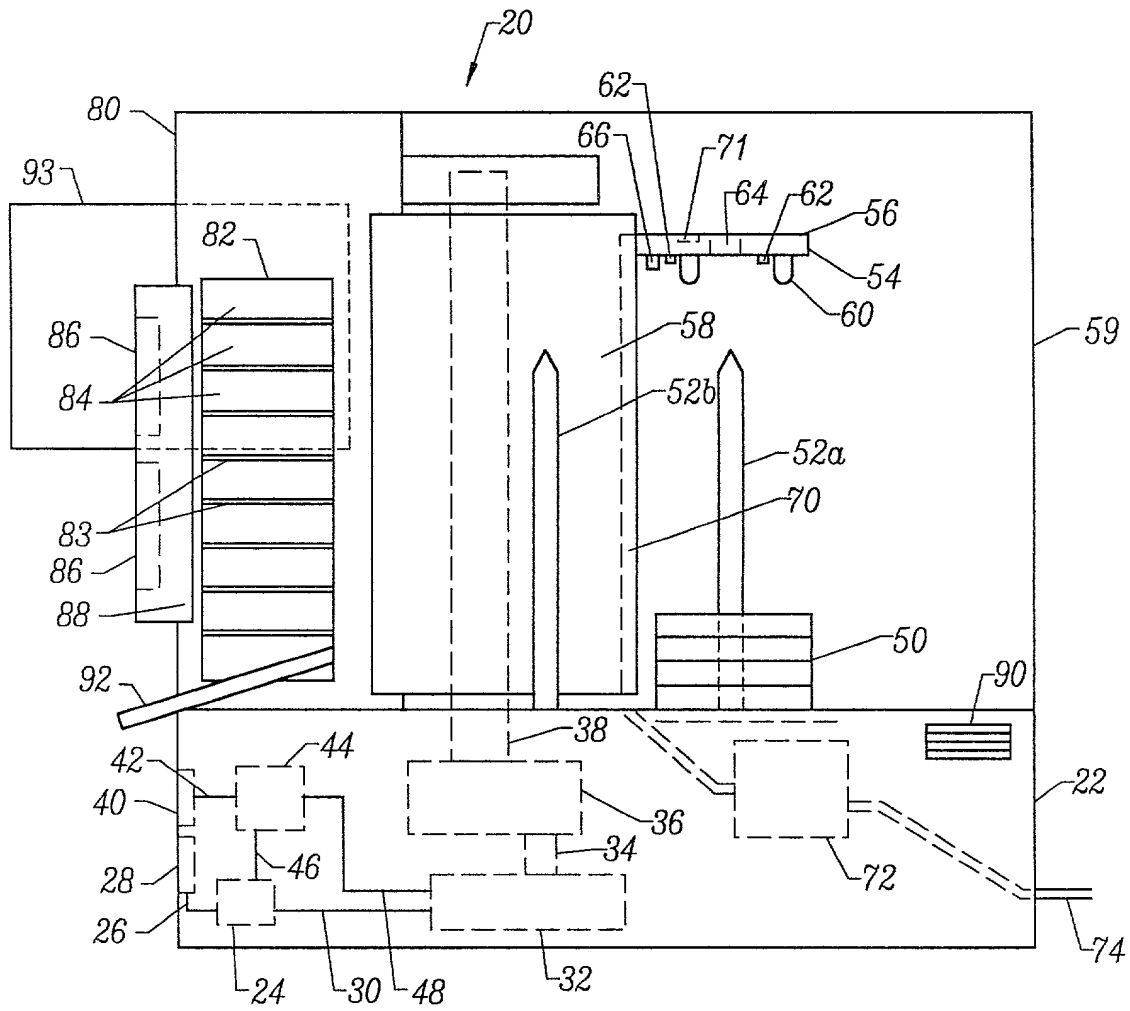


FIG. 2

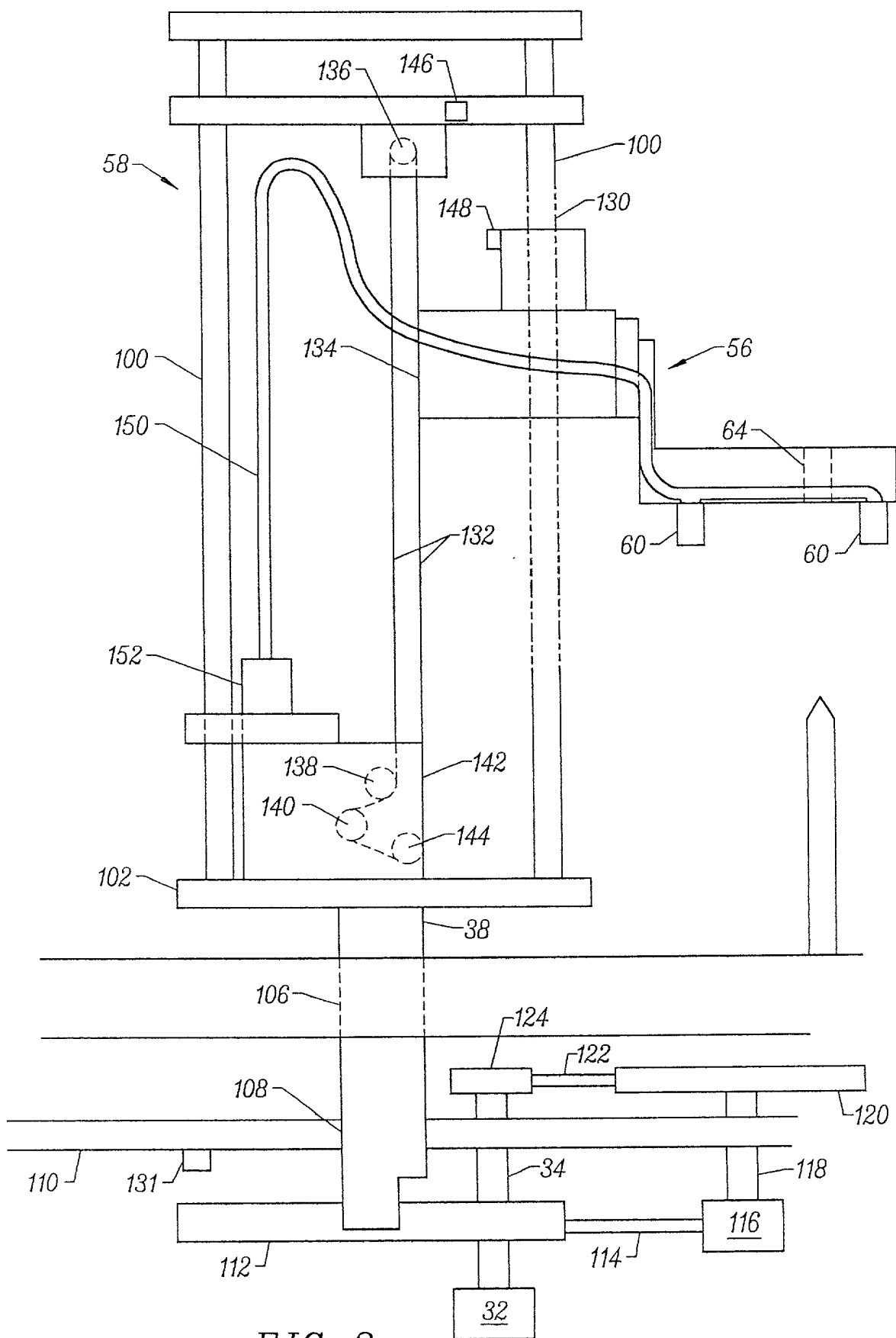
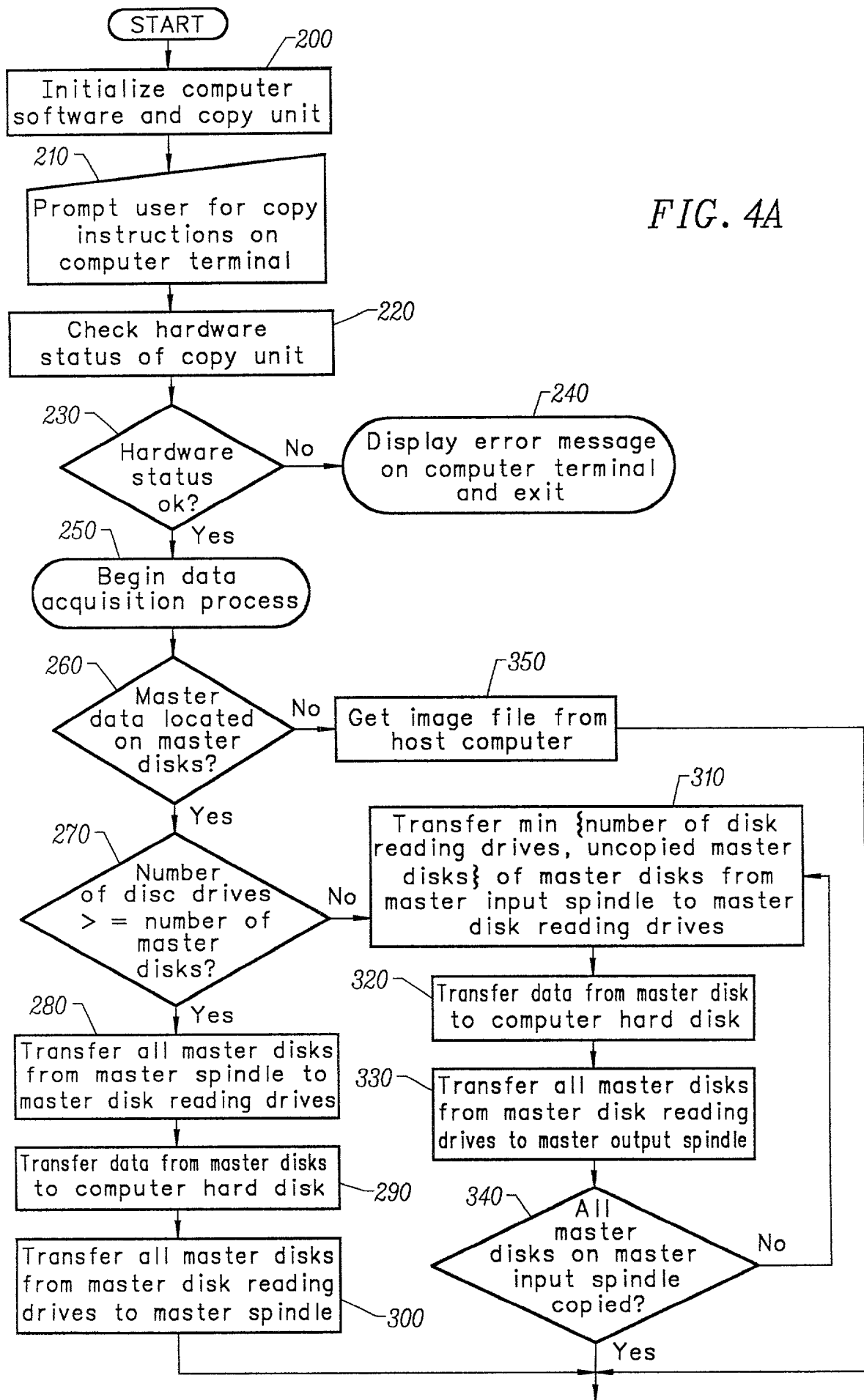


FIG. 3



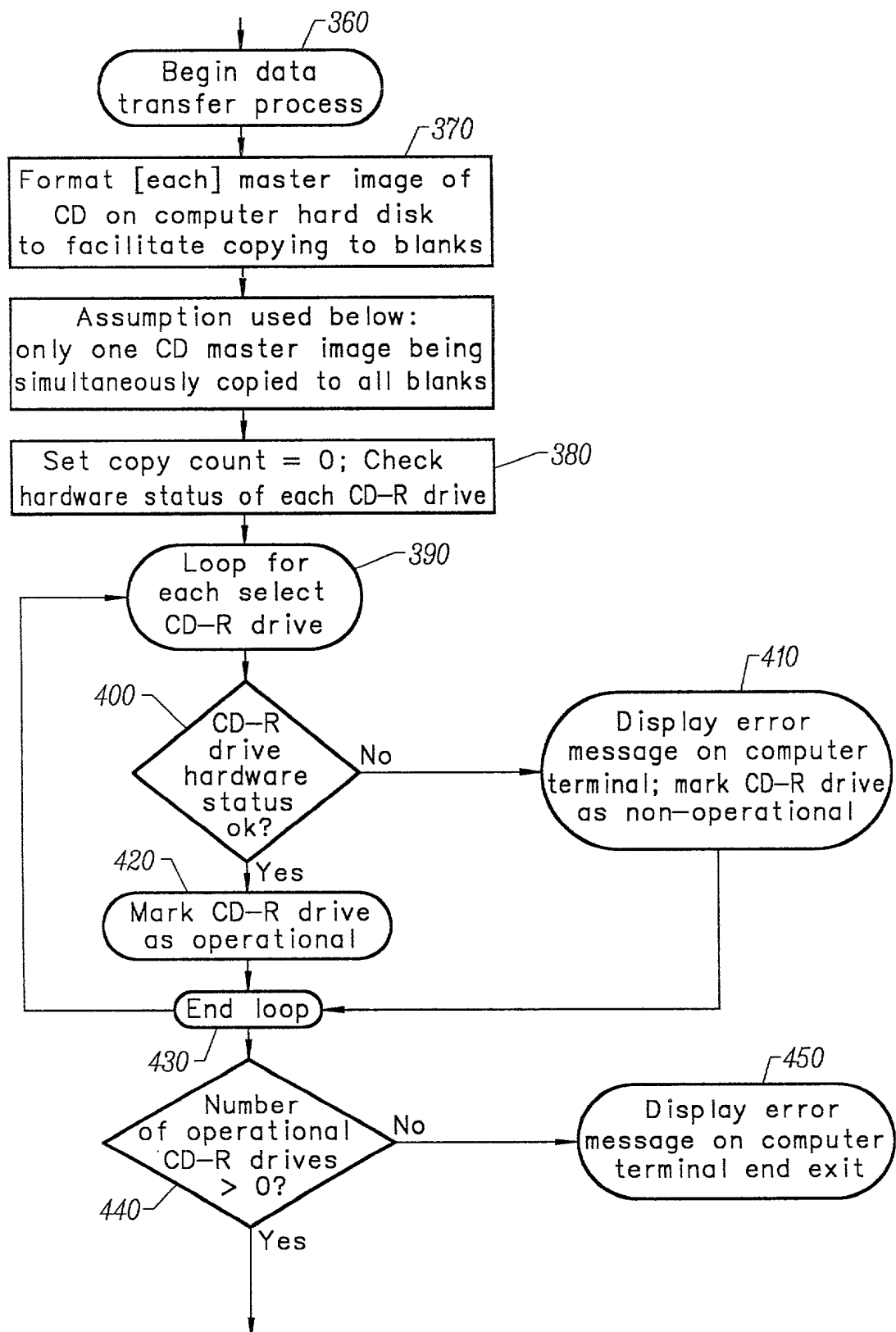
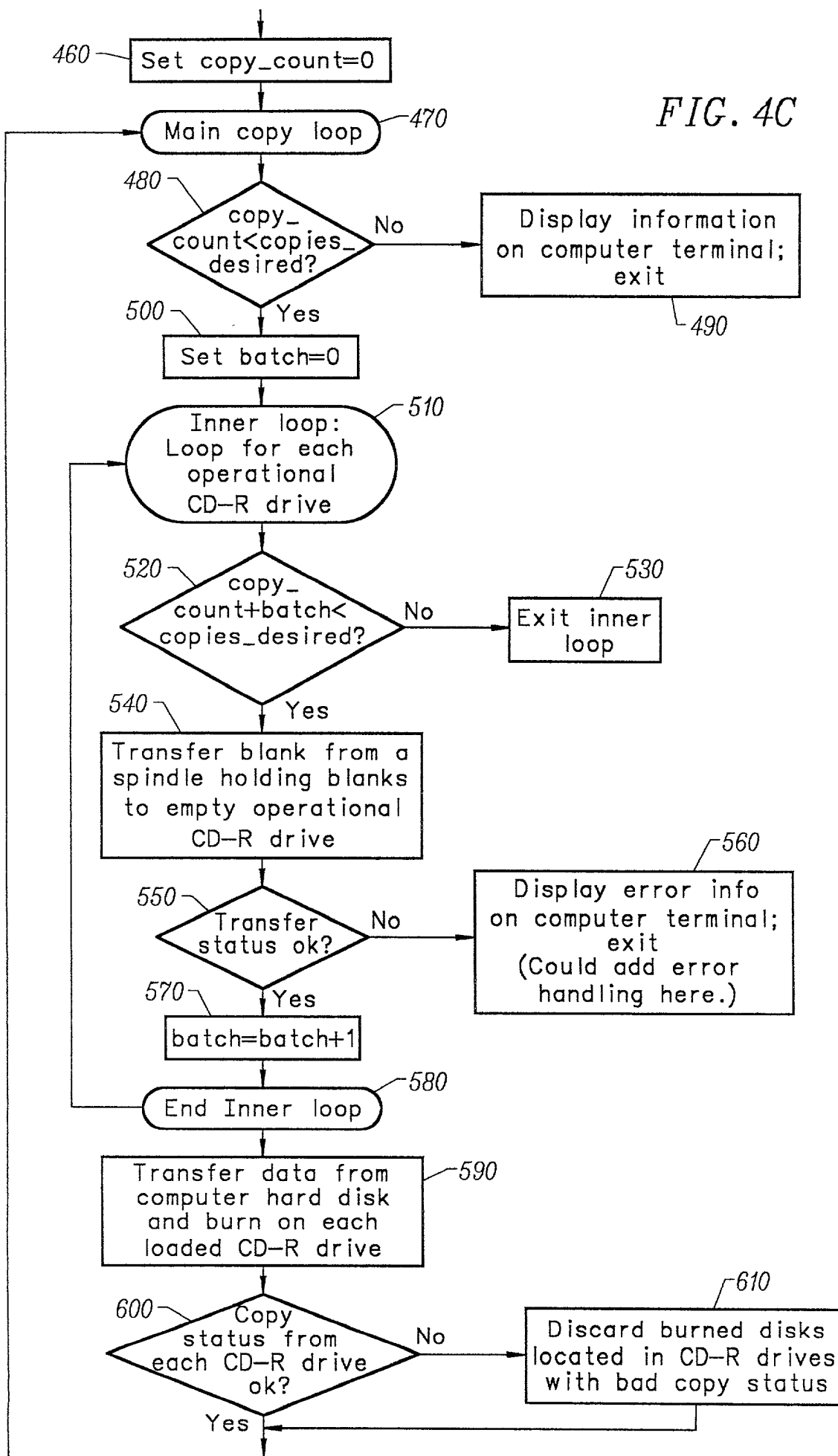


FIG. 4B

FIG. 4C



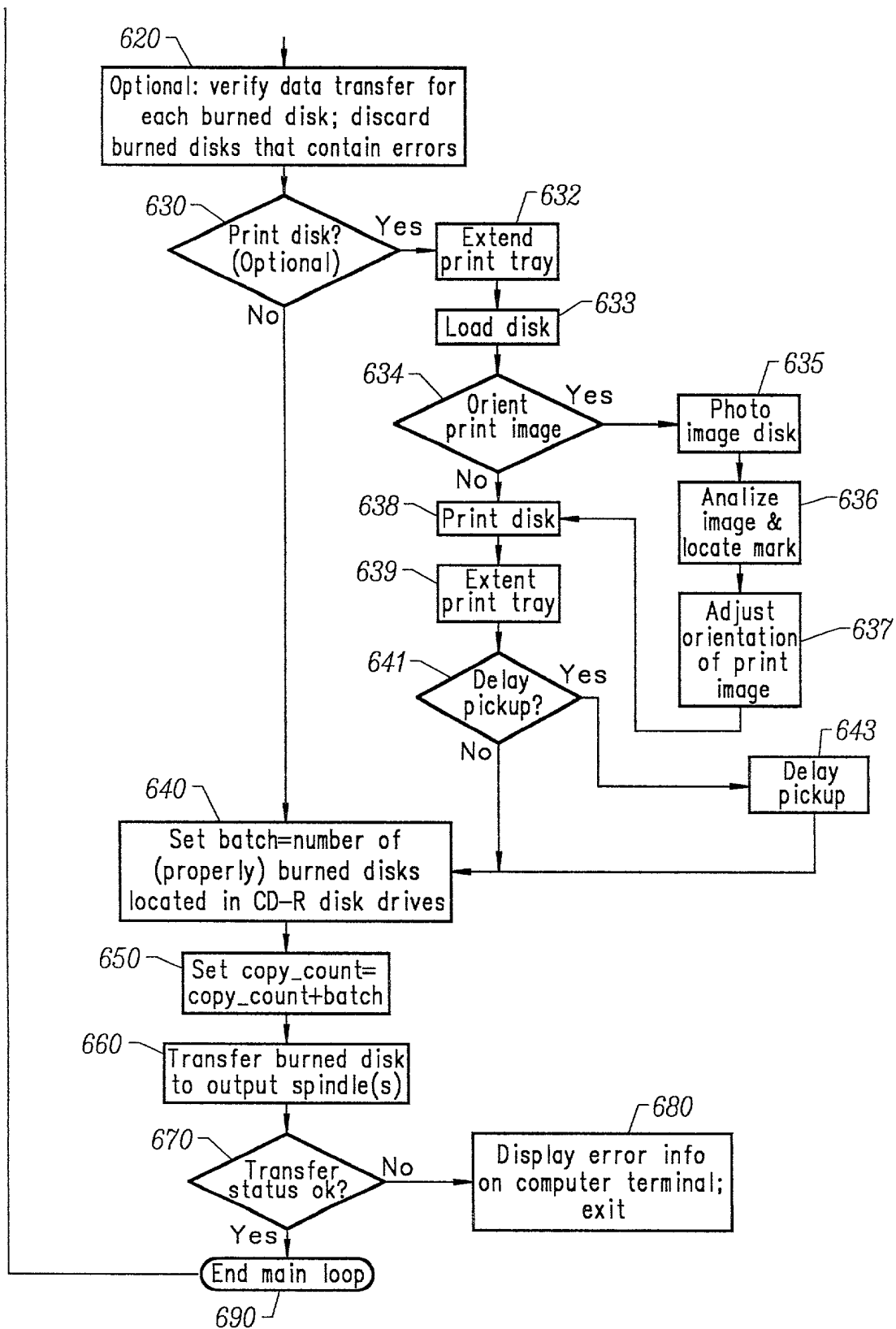


FIG. 4D

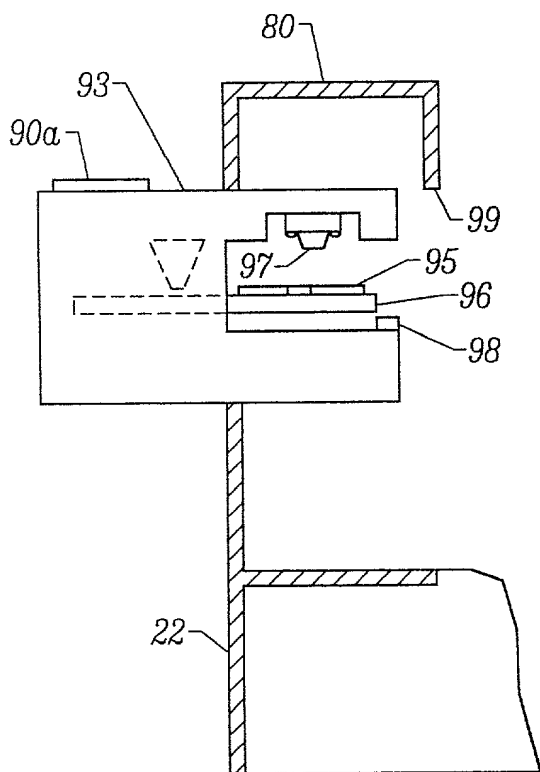


FIG. 5A

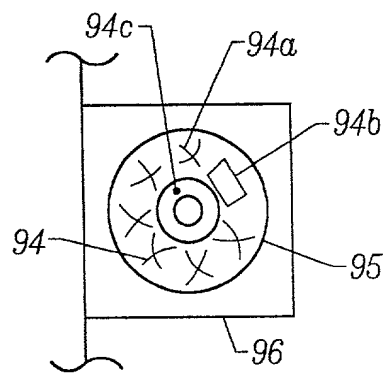


FIG. 5B

Please type a plus sign (+) inside this box → **+**

PTO/SB/01 (12-97)
Approved for use through 9/30/00. OMB 0651-0032
Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)	Attorney Docket Number	13240(A)
	First Named Inventor	MILLER, DAVID
	COMPLETE IF KNOWN	
	Application Number	/
	Filing Date	
	Group Art Unit	
<input checked="" type="checkbox"/> Declaration Submitted with Initial Filing	OR	<input type="checkbox"/> Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)
	Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

**PROGRAMMABLE SELF-OPERATING COMPACT DISK
DUPLICATION SYSTEM**

the specification of which (Title of the Invention)

☒ is attached hereto
OR
☐ was filed on (MM/DD/YYYY) [] as United States Application Number or PCT International Application Number [] and was amended on (MM/DD/YYYY) [] (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached?	
				YES	NO
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)

☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

[Page 1 of 2]

Burden Hour Statement: This form is estimated to take 0.4 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

Please type a plus sign (+) inside this box → ☐

PTO/SB/01 (12-97)

Approved for use through 9/30/00. OMB 0651-0032

Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

DECLARATION — Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)
09/152,815	09/14/1998	

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: ☐ Customer Number OR ☒ Registered practitioner(s) name/registration number listed below

Place Customer Number Bar Code Label here

Name	Registration Number	Name	Registration Number
Richard Esty Peterson	26,495		

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.


Direct all correspondence to: ☐ Customer Number OR ☒ Correspondence address below

Name	RICHARD ESTY PETERSON				
Address	PATENT ATTORNEY				
Address	1905-D PALMETTO AVENUE				
City	PACIFICA	State	CA	ZIP	94044
Country	United States	Telephone	(650) 557-5708	Fax	(650) 557-5716

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor:

☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])		Family Name or Surname					
DAVID		MILLER					
Inventor's Signature					Date	10/23/00	
Residence: City	Orinda	State	CA	Country	United States	Citizenship	USA
Post Office Address	20 La Espiral						
Post Office Address							
City	Orinda	State	CA	ZIP	94563	Country	United States

☐ Additional inventors are being named on the _____ supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto.